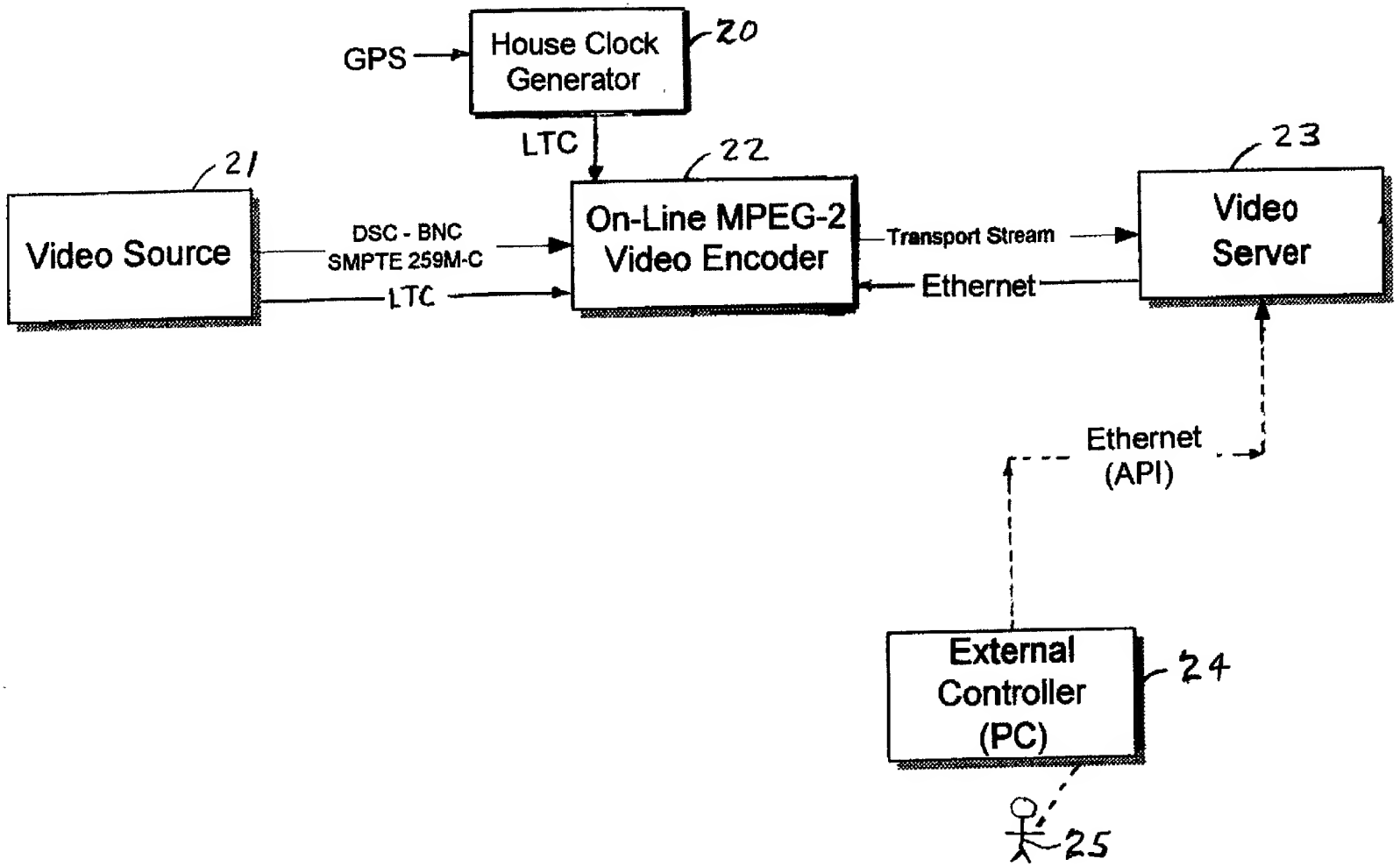
GPS
House Clock Generator
20
LTC
21
22
23
Video Source
DSC - BNC
SMPTE 259M-C
LTC
On-Line MPEG-2 Video Encoder
Transport Stream
Ethernet
Video Server
Ethernet (API)
External Controller (PC)
24
25

FIG. 1

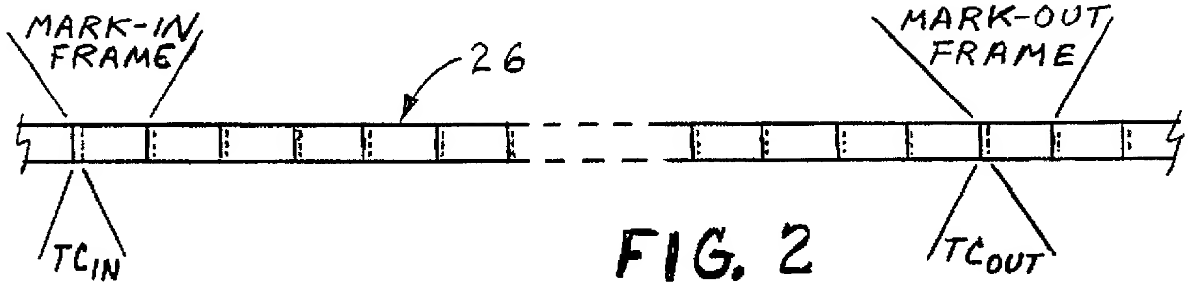

FIG. 2

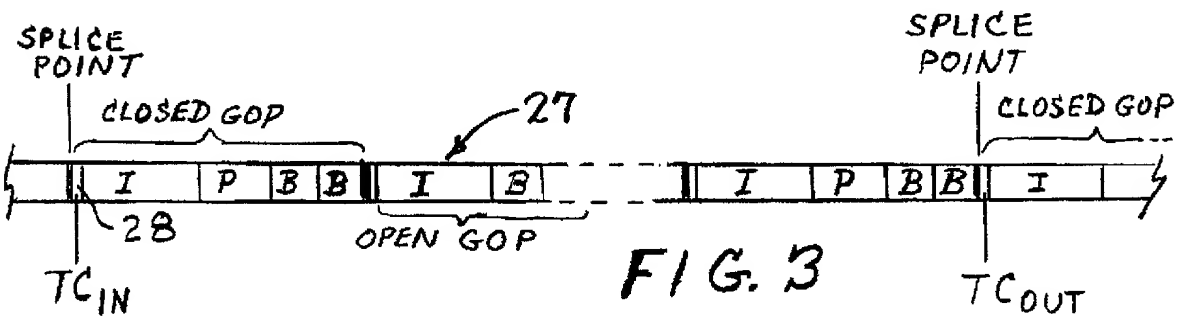

FIG. 3

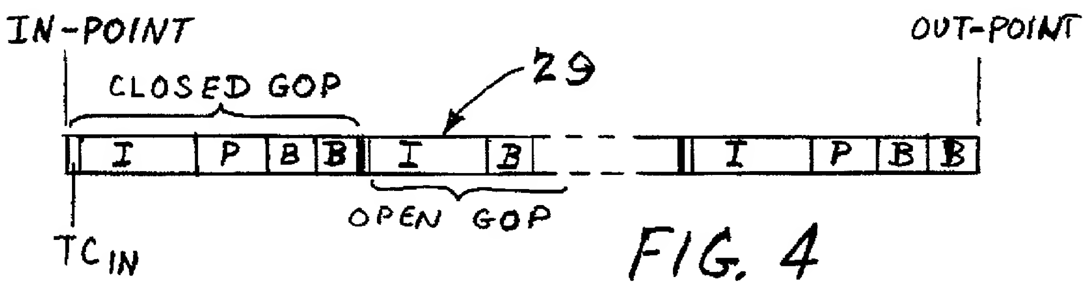

FIG. 4

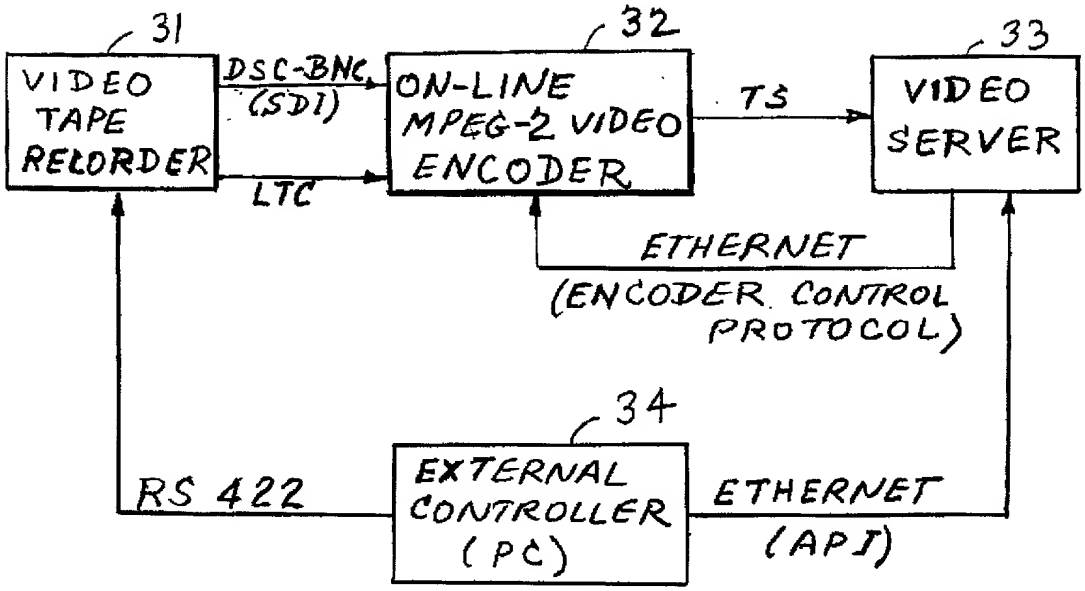
31
VIDEO TAPE RECORDER
DSC-BNC (SDI)
LTC
32
ON-LINE MPEG-2 VIDEO ENCODER
TS
33
VIDEO SERVER
ETHERNET (ENCODER CONTROL PROTOCOL)
34
EXTERNAL CONTROLLER (PC)
RS 422
ETHERNET (API)

FIG. 5

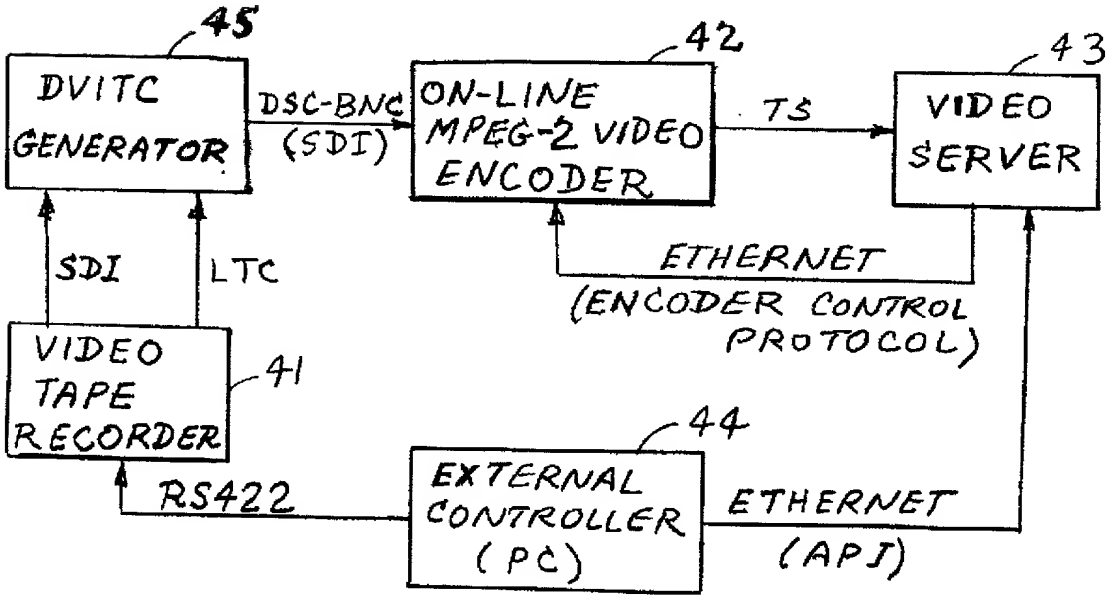
45
DVITC GENERATOR
DSC-BNC (SDI)
42
ON-LINE MPEG-2 VIDEO ENCODER
TS
43
VIDEO SERVER
SDI
LTC
ETHERNET (ENCODER CONTROL PROTOCOL)
VIDEO TAPE RECORDER
41
44
EXTERNAL CONTROLLER (PC)
RS422
ETHERNET (API)

FIG. 6

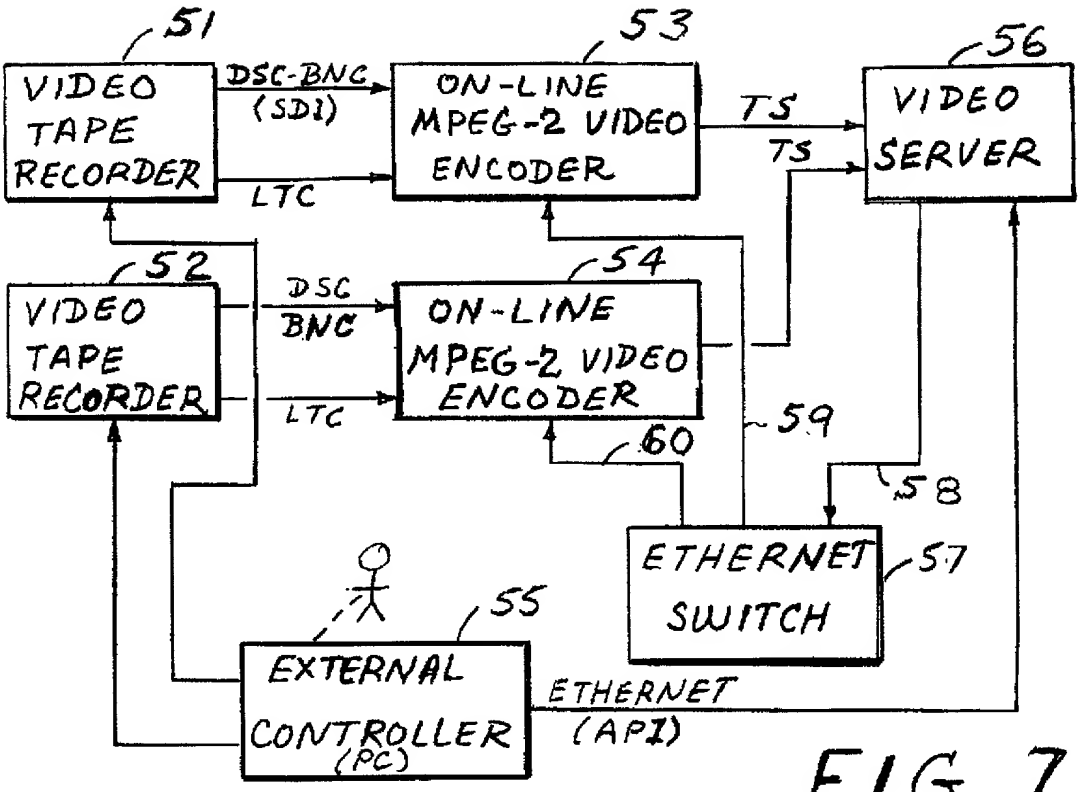
51
VIDEO TAPE RECORDER
DSC-BNC (SDI)
LTC
53
ON-LINE MPEG-2 VIDEO ENCODER
TS
TS
56
VIDEO SERVER
52
VIDEO TAPE RECORDER
DSC BNC
LTC
54
ON-LINE MPEG-2 VIDEO ENCODER
59
60
58
ETHERNET SWITCH
57
55
EXTERNAL CONTROLLER (PC)
ETHERNET (API)

FIG. 7

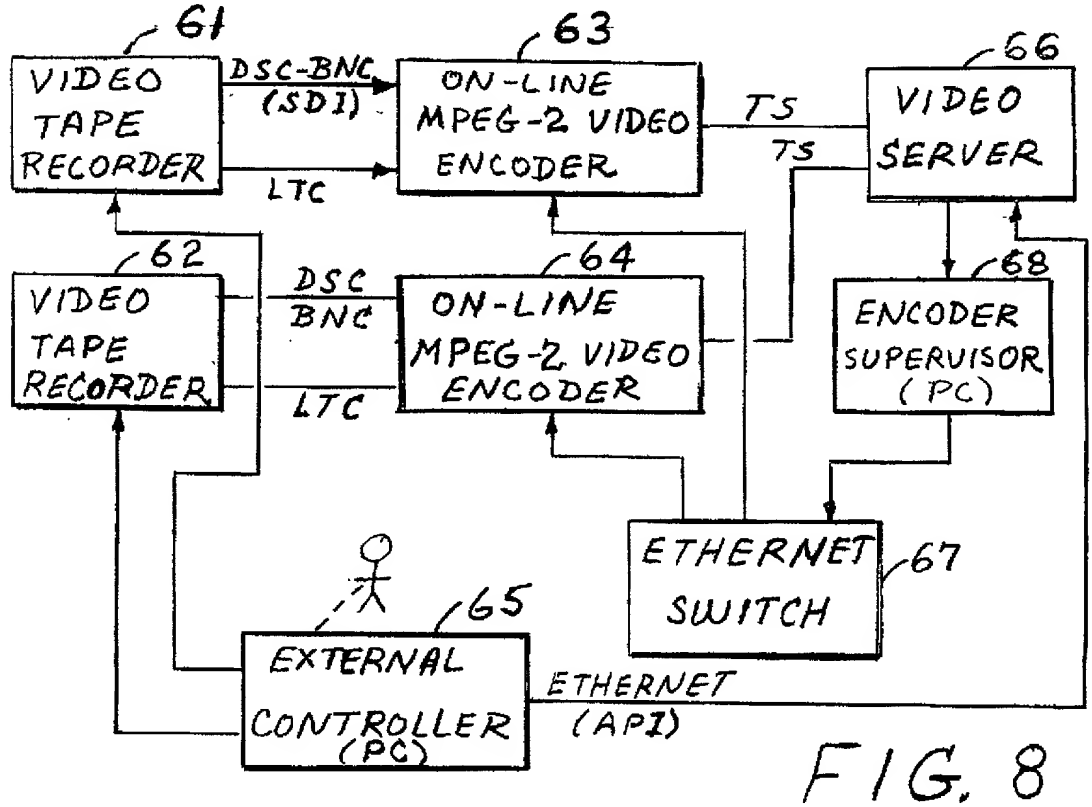
61
VIDEO TAPE RECORDER
DSC-BNC (SDI)
LTC
63
ON-LINE MPEG-2 VIDEO ENCODER
TS
TS
66
VIDEO SERVER
62
VIDEO TAPE RECORDER
DSC BNC
LTC
64
ON-LINE MPEG-2 VIDEO ENCODER
68
ENCODER SUPERVISOR (PC)
ETHERNET SWITCH
67
65
EXTERNAL CONTROLLER (PC)
ETHERNET (API)

FIG. 8

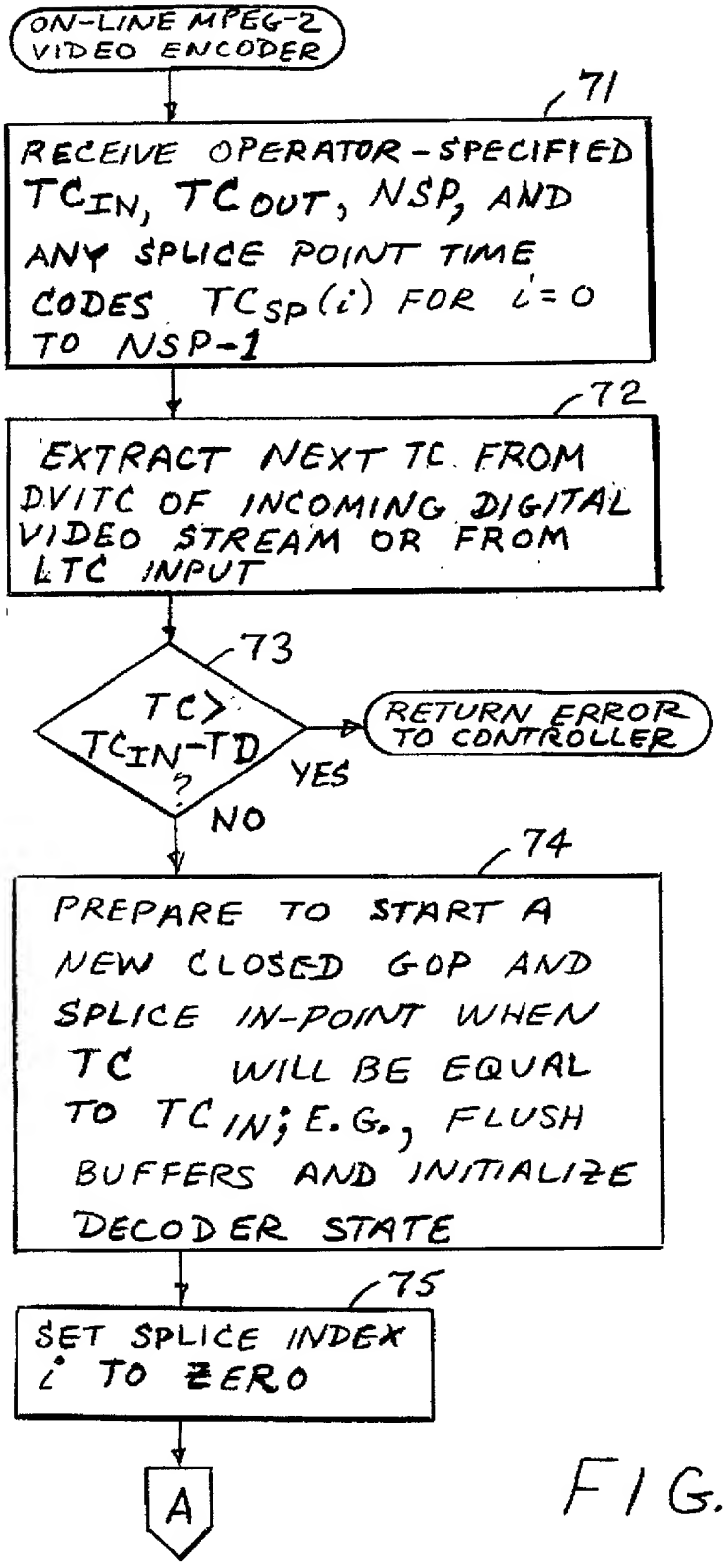
ON-LINE MPEG-2 VIDEO ENCODER
71
RECEIVE OPERATOR-SPECIFIED TC_{IN}, TC_{OUT}, NSP, AND ANY SPLICE POINT TIME CODES $TC_{SP}(i)$ FOR $i = 0$ TO NSP-1
72
EXTRACT NEXT TC FROM DVITC OF INCOMING DIGITAL VIDEO STREAM OR FROM LTC INPUT
73
$TC > TC_{IN} - TD$?
YES
RETURN ERROR TO CONTROLLER
NO
74
PREPARE TO START A NEW CLOSED GOP AND SPLICE IN-POINT WHEN TC WILL BE EQUAL TO TC_{IN}; E.G., FLUSH BUFFERS AND INITIALIZE DECODER STATE
75
SET SPLICE INDEX i TO ZERO
A

FIG. 9

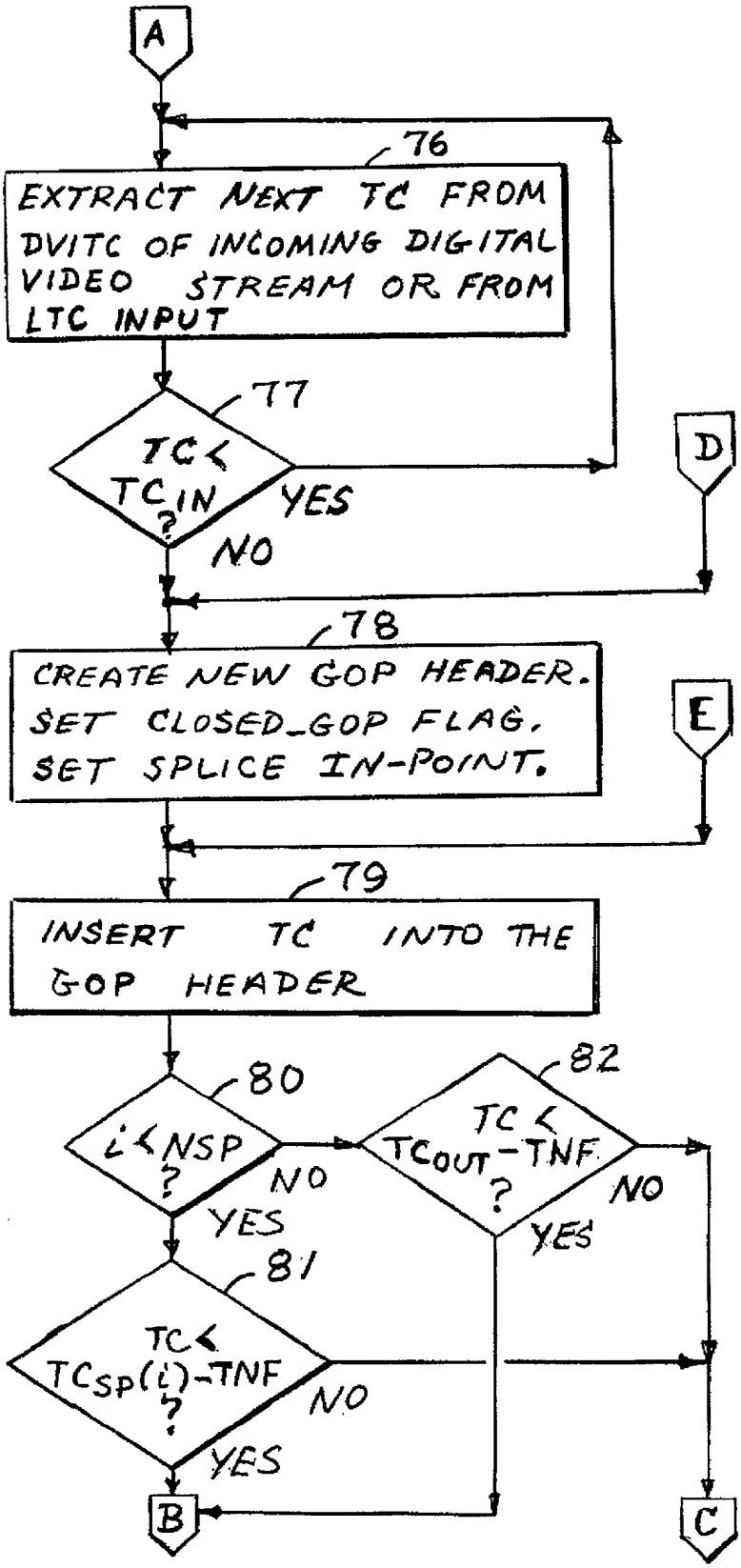
A
76
EXTRACT NEXT TC FROM DVITC OF INCOMING DIGITAL VIDEO STREAM OR FROM LTC INPUT
77
TC < TC_IN ?
YES
NO
D
78
CREATE NEW GOP HEADER. SET CLOSED_GOP FLAG. SET SPLICE IN-POINT.
E
79
INSERT TC INTO THE GOP HEADER
80
i < NSP ?
NO
YES
82
TC < TC_OUT - TNF ?
NO
YES
81
TC < TC_SP(i) - TNF ?
NO
YES
B
C

FIG. 10

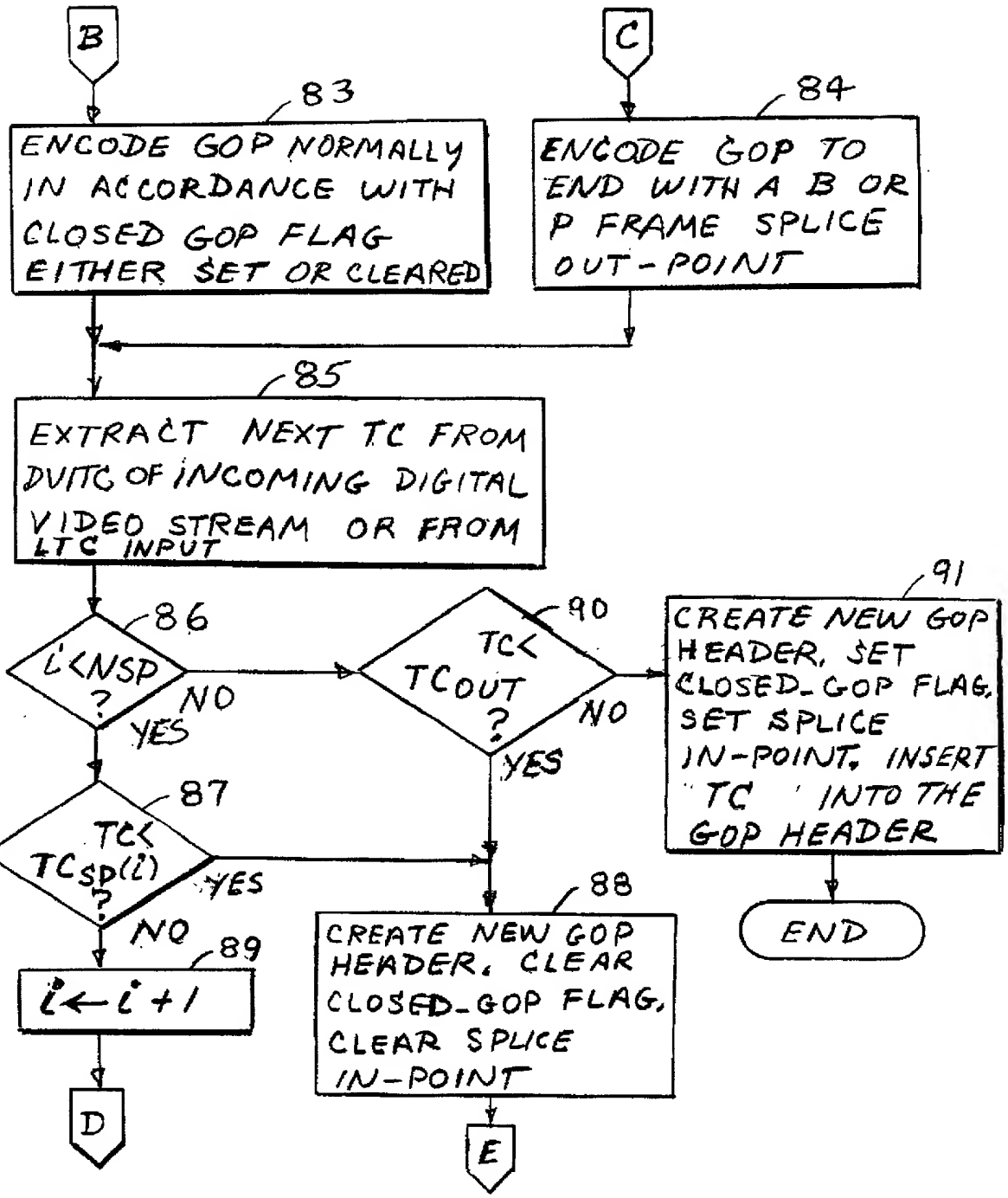
B
C
83
ENCODE GOP NORMALLY IN ACCORDANCE WITH CLOSED GOP FLAG EITHER SET OR CLEARED
84
ENCODE GOP TO END WITH A B OR P FRAME SPLICE OUT-POINT
85
EXTRACT NEXT TC FROM DVITC OF INCOMING DIGITAL VIDEO STREAM OR FROM LTC INPUT
86
i<NSP ?
NO
YES
90
TC< TCOUT ?
NO
YES
91
CREATE NEW GOP HEADER, SET CLOSED_GOP FLAG, SET SPLICE IN-POINT, INSERT TC INTO THE GOP HEADER
END
87
TC< TCSP(i) ?
YES
NO
88
CREATE NEW GOP HEADER, CLEAR CLOSED_GOP FLAG, CLEAR SPLICE IN-POINT
89
i ← i + 1
D
E

FIG. 11

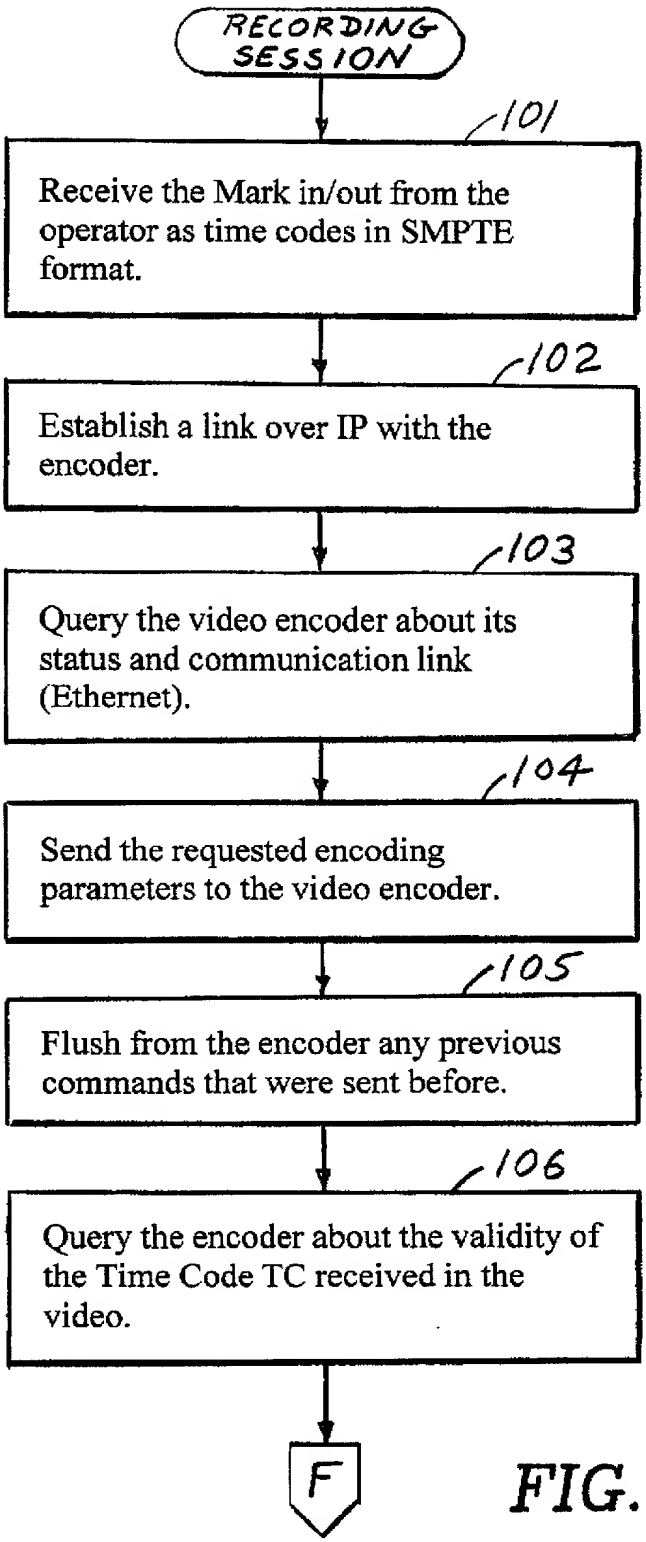
RECORDING SESSION
101
Receive the Mark in/out from the operator as time codes in SMPTE format.
102
Establish a link over IP with the encoder.
103
Query the video encoder about its status and communication link (Ethernet).
104
Send the requested encoding parameters to the video encoder.
105
Flush from the encoder any previous commands that were sent before.
106
Query the encoder about the validity of the Time Code TC received in the video.
F

FIG. 12

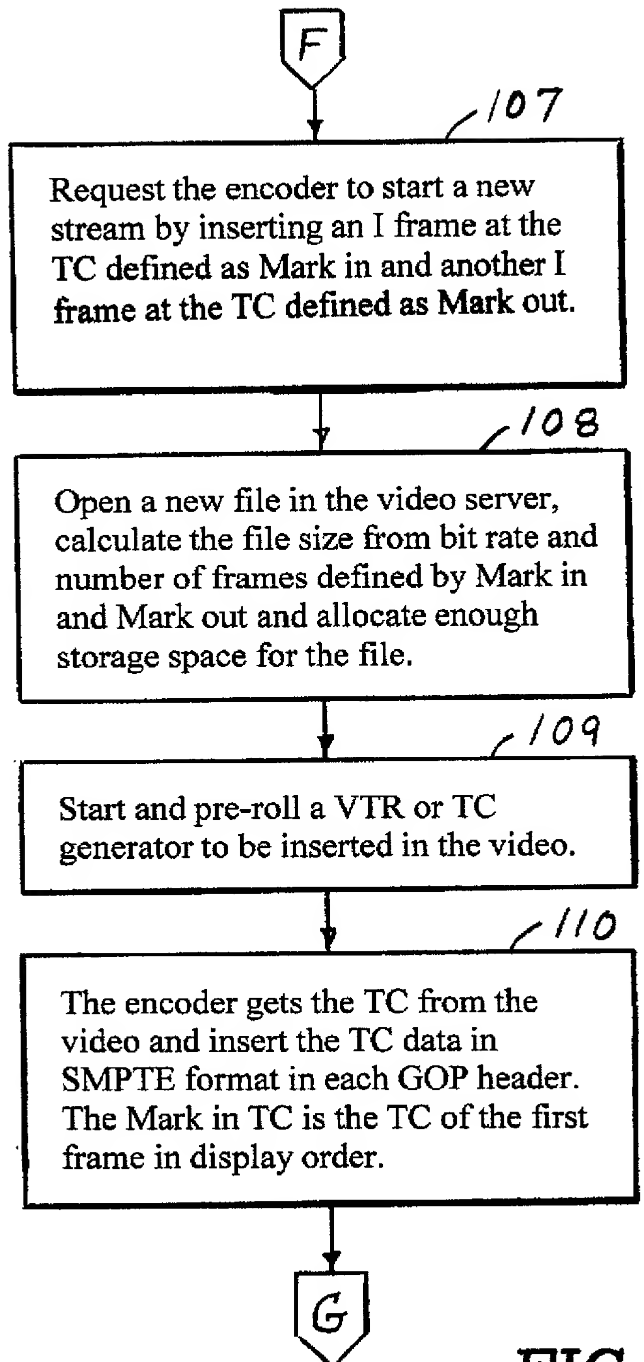
F
107
Request the encoder to start a new stream by inserting an I frame at the TC defined as Mark in and another I frame at the TC defined as Mark out.
108
Open a new file in the video server, calculate the file size from bit rate and number of frames defined by Mark in and Mark out and allocate enough storage space for the file.
109
Start and pre-roll a VTR or TC generator to be inserted in the video.
110
The encoder gets the TC from the video and insert the TC data in SMPTE format in each GOP header. The Mark in TC is the TC of the first frame in display order.
G

FIG. 13

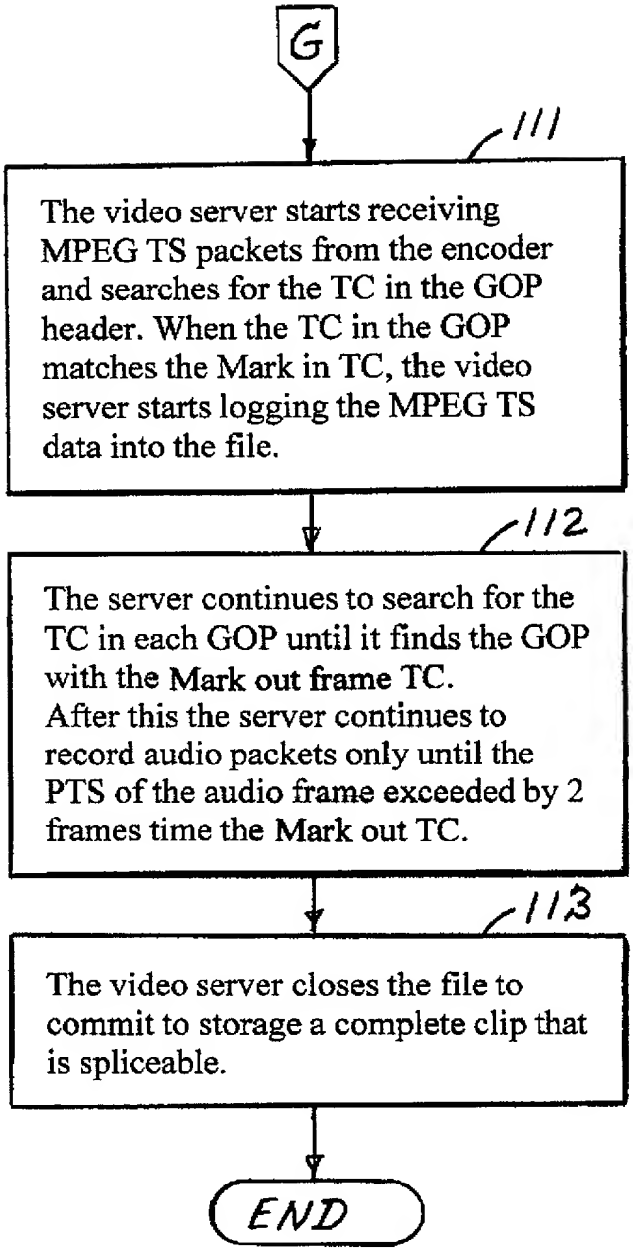
G
111
The video server starts receiving MPEG TS packets from the encoder and searches for the TC in the GOP header. When the TC in the GOP matches the Mark in TC, the video server starts logging the MPEG TS data into the file.
112
The server continues to search for the TC in each GOP until it finds the GOP with the Mark out frame TC.
After this the server continues to record audio packets only until the PTS of the audio frame exceeded by 2 frames time the Mark out TC.
113
The video server closes the file to commit to storage a complete clip that is spliceable.
END

FIG. 14

STREAM #1 BEST ALIGNED APU SHORT INTO THE CUT ($\Delta_1>0$)	STREAM #2 BEST ALIGNED APU SHORT INTO THE CUT ($\Delta_2<0$)	12 MSEC. < AUDIO GAP < 24 MSEC. ($\Delta_1-\Delta_2$)	FIGS. 16A, 16B, 16C
		0 MSEC. < AUDIO GAP < 12 MSEC. ($\Delta_1-\Delta_2$)	FIGS. 17A, 17B
	STREAM #2 BEST ALIGNED APU LONG INTO THE CUT ($\Delta_2>0$)	0 MSEC. < AUDIO GAP < 12 MSEC. ($\Delta_1-\Delta_2$)	FIGS. 18A, 18B
		0 MSEC. < AUDIO OVERLAP < 12 MSEC. ($\Delta_2-\Delta_1$)	FIGS. 19A, 19B
STREAM #1 BEST ALIGNED APU LONG INTO THE CUT ($\Delta_1<0$)	STREAM #2 BEST ALIGNED APU SHORT INTO THE CUT ($\Delta_2<0$)	0 MSEC. < AUDIO GAP < 12 MSEC. ($\Delta_1-\Delta_2$)	FIGS. 20A, 20B
		0 MSEC. < AUDIO OVERLAP < 12 MSEC. ($\Delta_2-\Delta_1$)	FIGS. 21A, 21B
	STREAM #2 BEST ALIGNED APU LONG INTO THE CUT ($\Delta_2>0$)	12 MSEC. < AUDIO OVERLAP < 24 MSEC. ($\Delta_2-\Delta_1$)	FIGS. 22A, 22B, 22C
		0 MSEC. < AUDIO OVERLAP < 12 MSEC. ($\Delta_2-\Delta_1$)	FIGS. 23A, 23B

FIG. 15

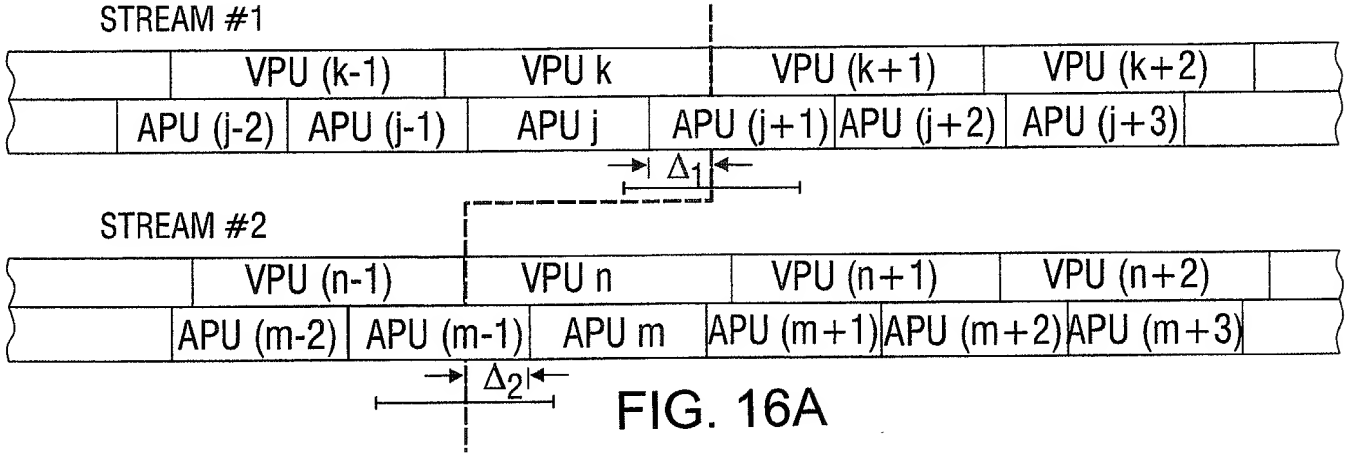

FIG. 16A

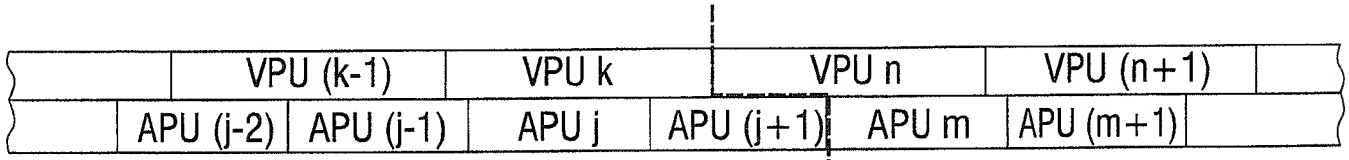

FIG. 16B

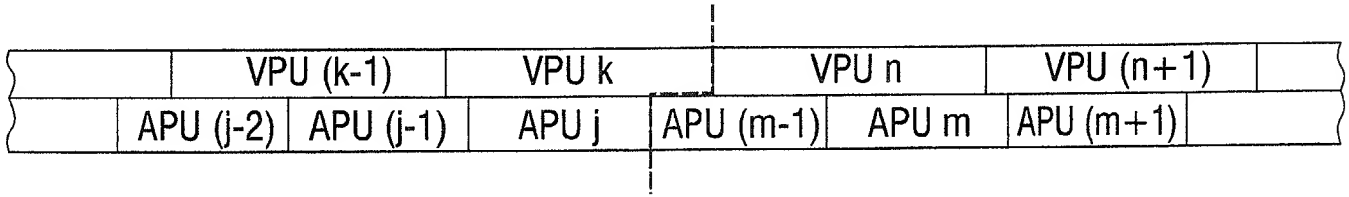

FIG. 16C

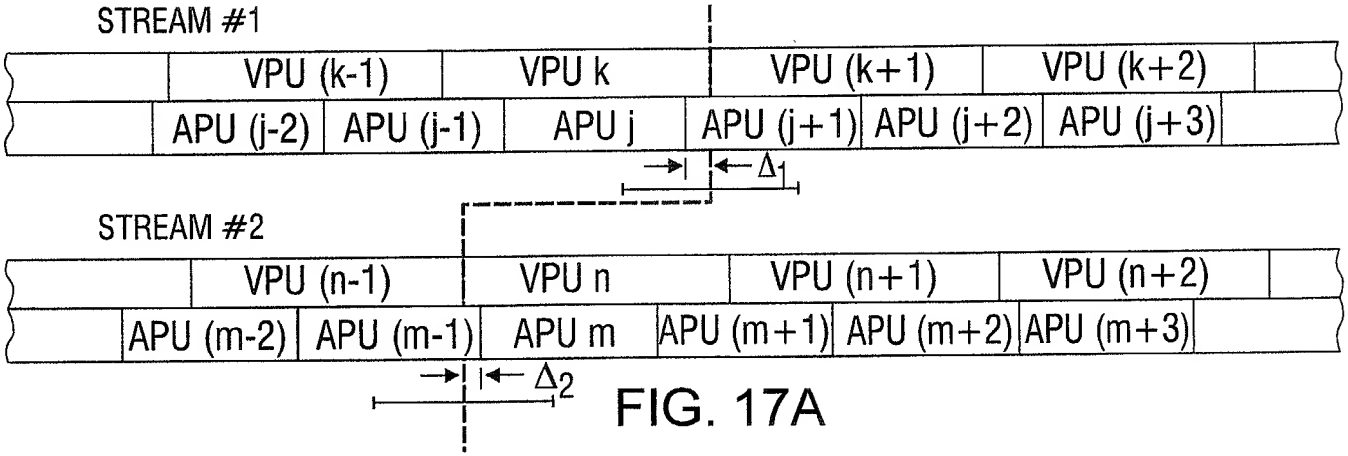

FIG. 17A

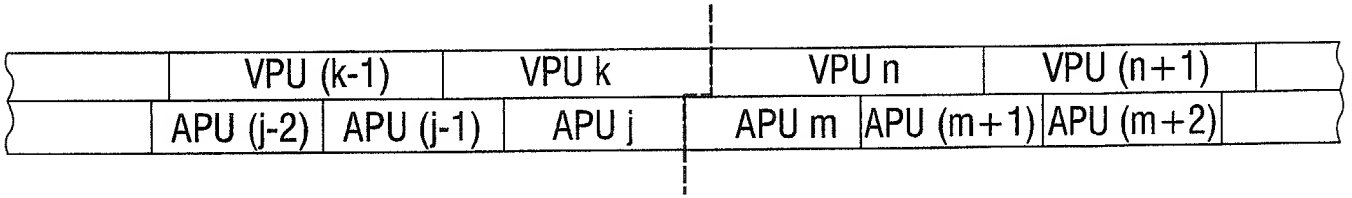

FIG. 17B

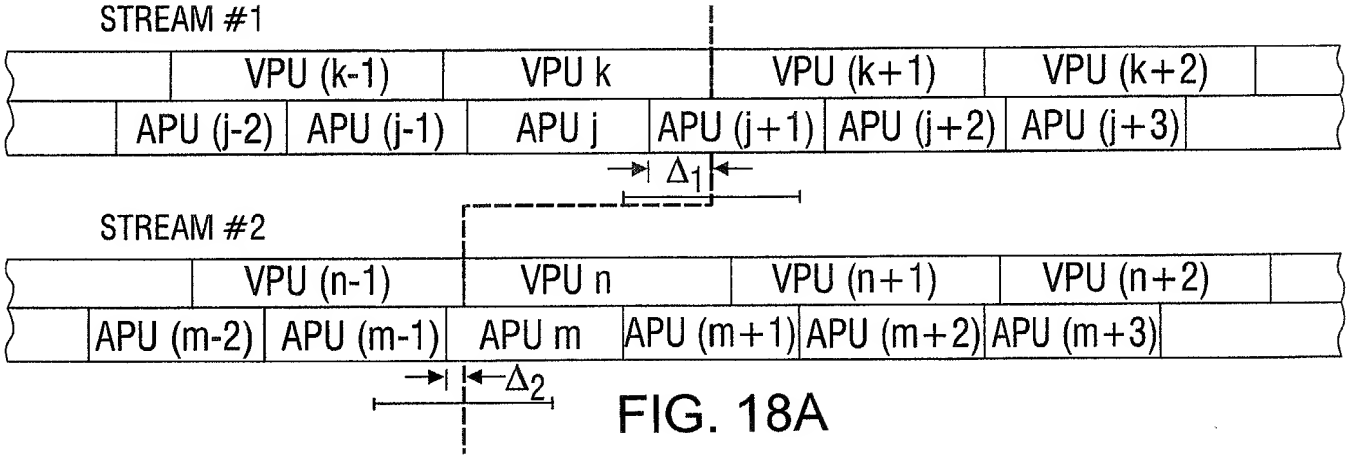

FIG. 18A

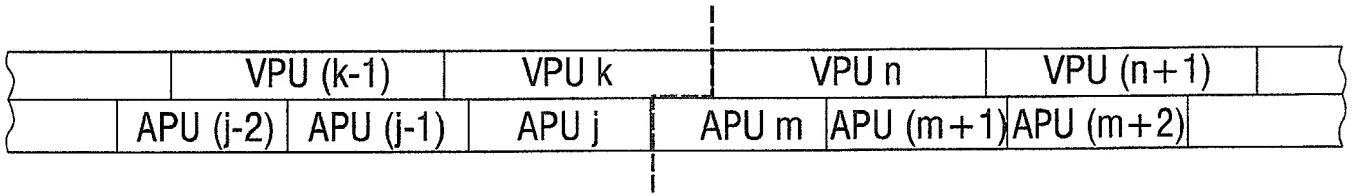

FIG. 18B

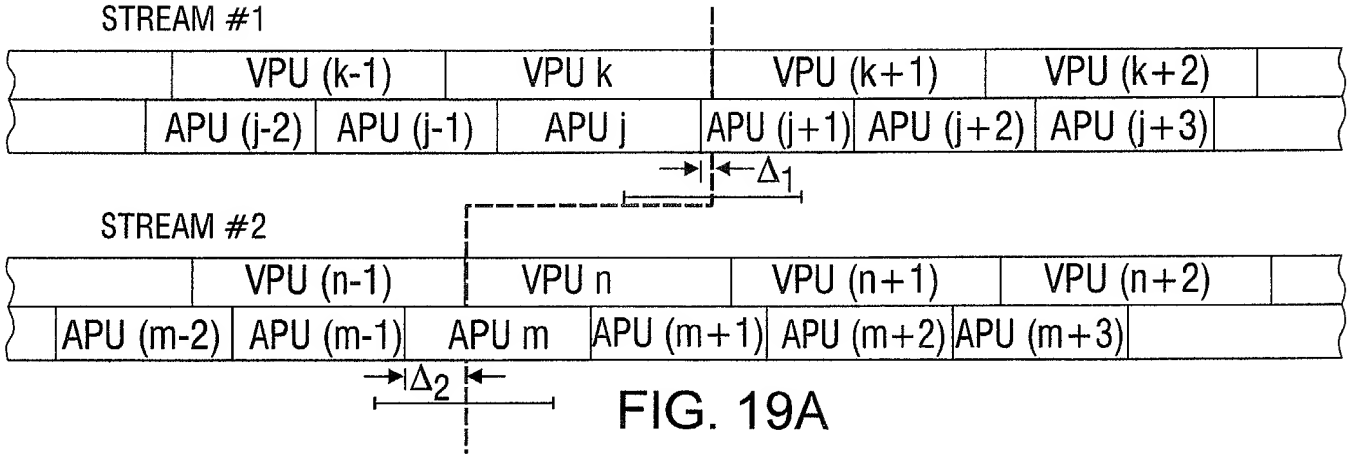

FIG. 19A

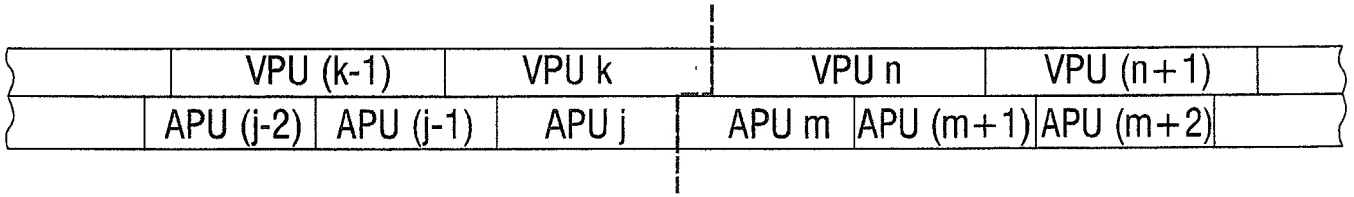

FIG. 19B

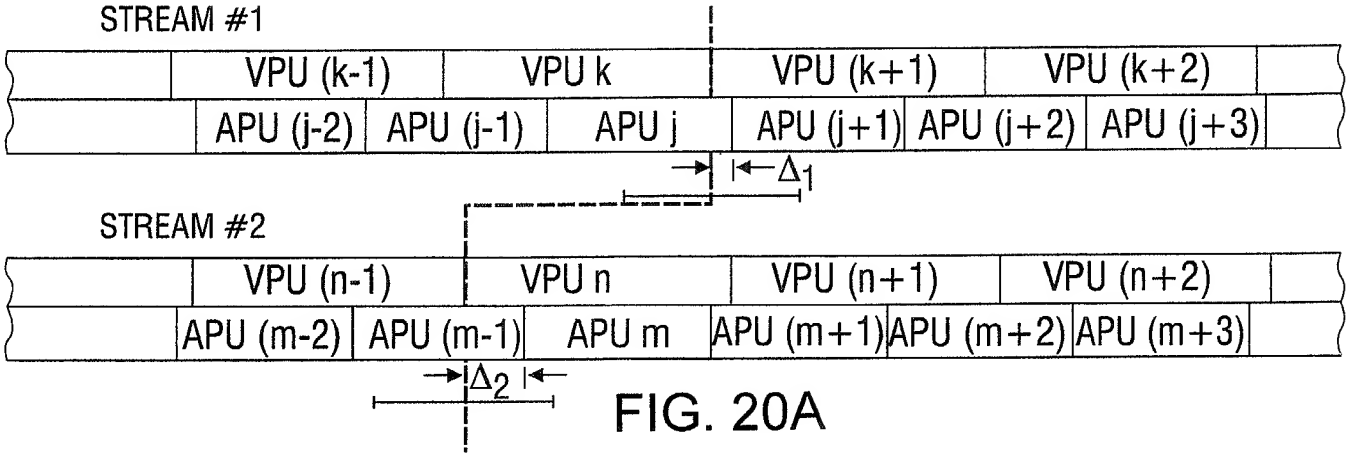

FIG. 20A

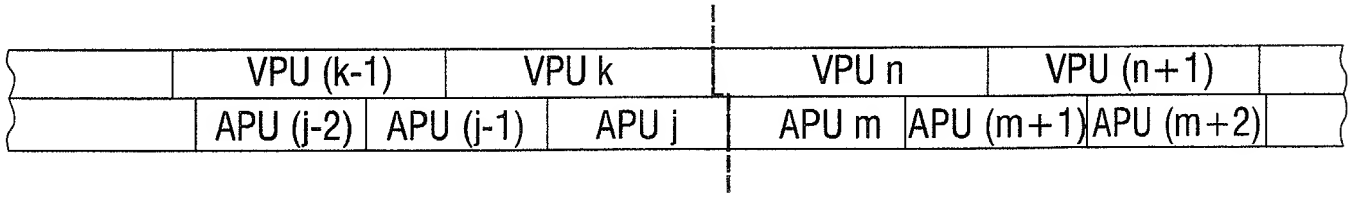

FIG. 20B

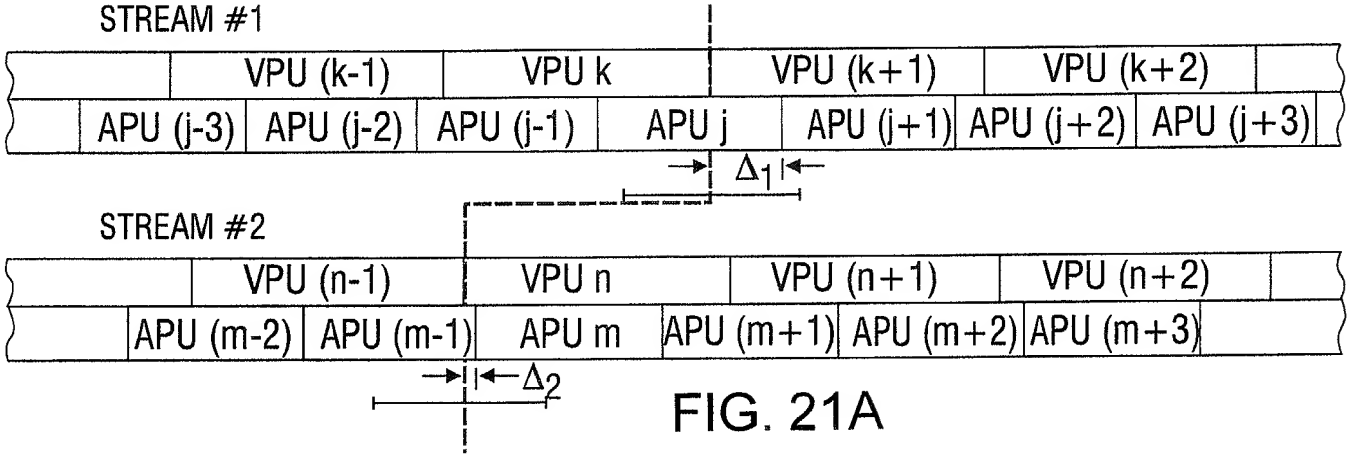

FIG. 21A

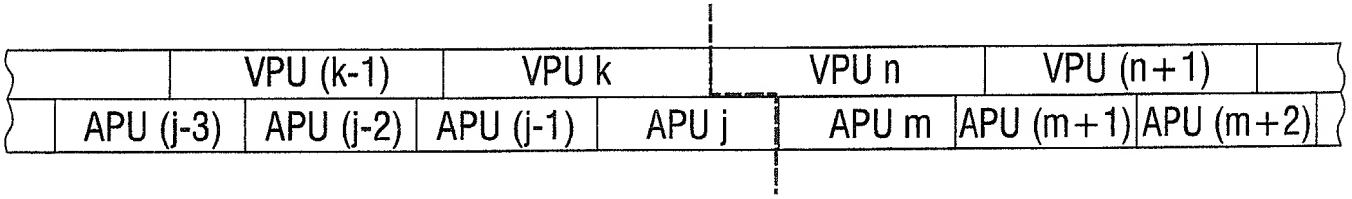

FIG. 21B

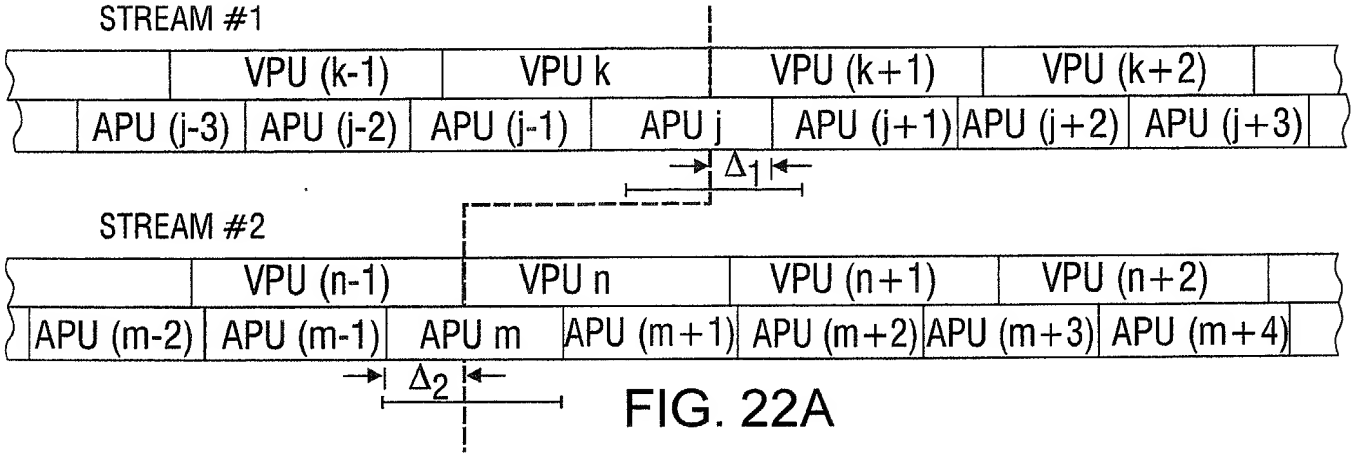

FIG. 22A

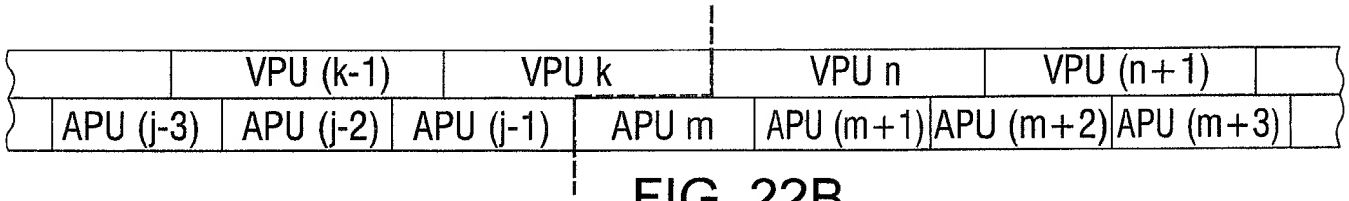

FIG. 22B

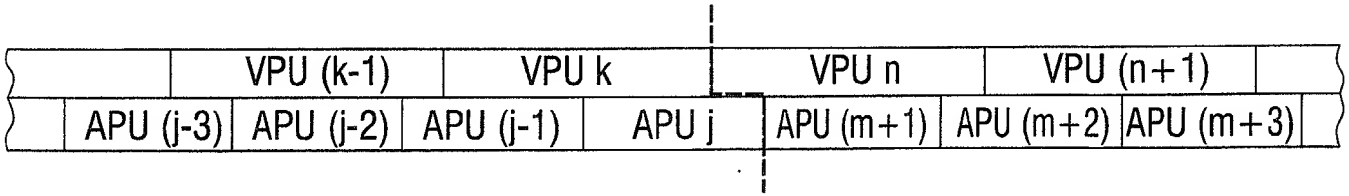

FIG. 22C

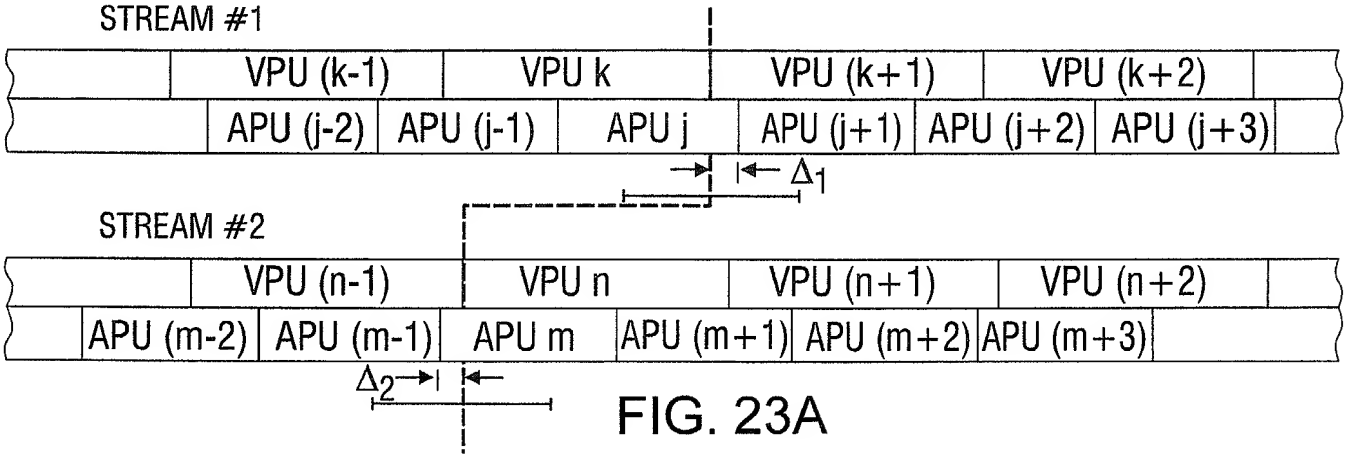

FIG. 23A

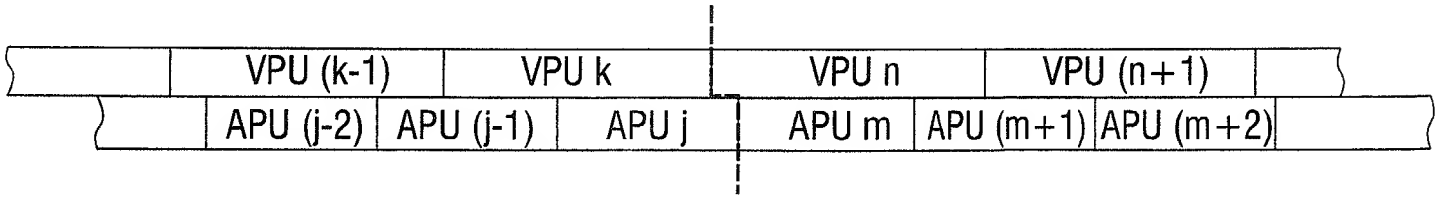

FIG. 23B

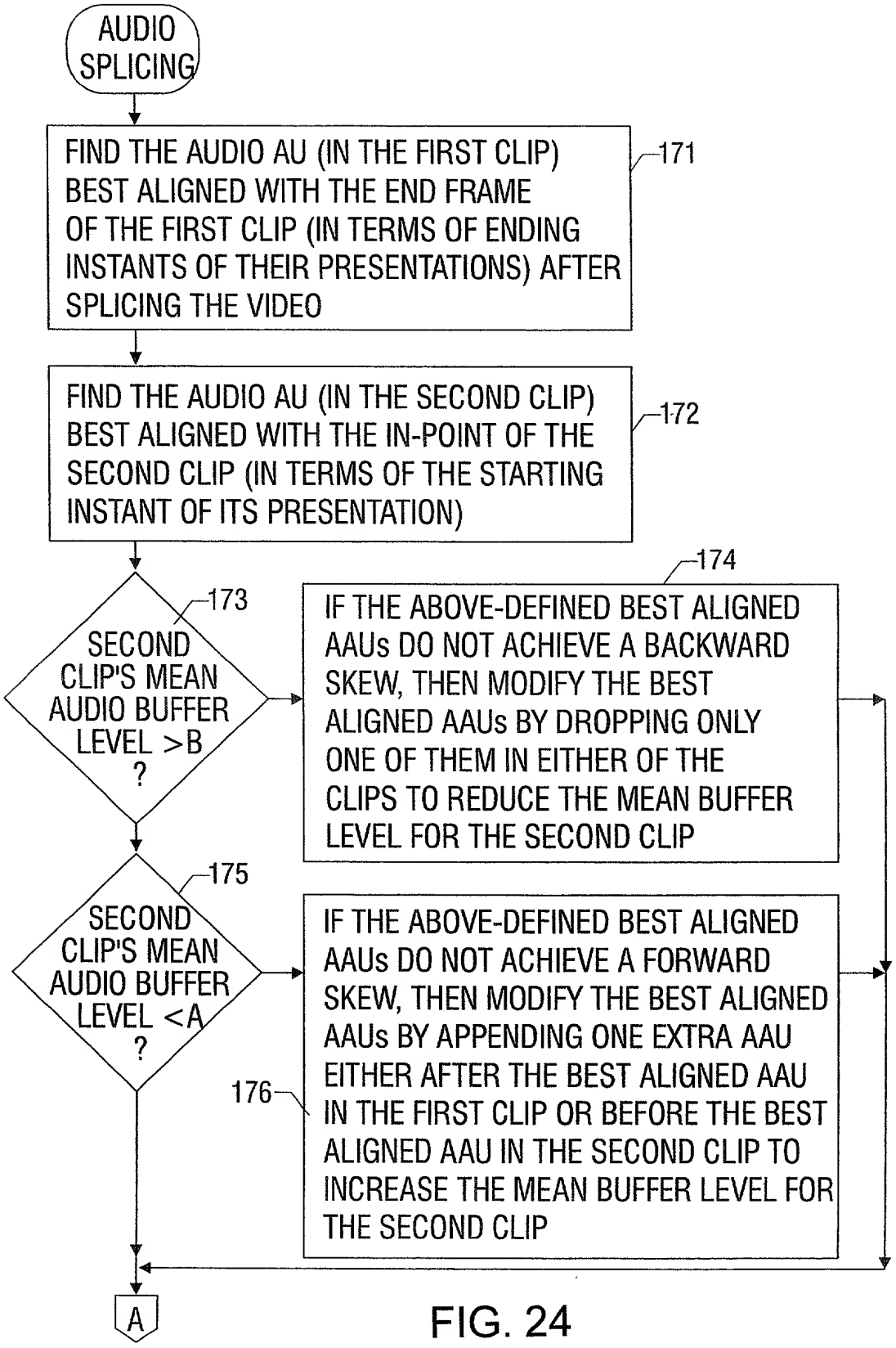
AUDIO SPLICING
FIND THE AUDIO AU (IN THE FIRST CLIP) BEST ALIGNED WITH THE END FRAME OF THE FIRST CLIP (IN TERMS OF ENDING INSTANTS OF THEIR PRESENTATIONS) AFTER SPLICING THE VIDEO
171
FIND THE AUDIO AU (IN THE SECOND CLIP) BEST ALIGNED WITH THE IN-POINT OF THE SECOND CLIP (IN TERMS OF THE STARTING INSTANT OF ITS PRESENTATION)
172
SECOND CLIP'S MEAN AUDIO BUFFER LEVEL >B ?
173
IF THE ABOVE-DEFINED BEST ALIGNED AAUs DO NOT ACHIEVE A BACKWARD SKEW, THEN MODIFY THE BEST ALIGNED AAUs BY DROPPING ONLY ONE OF THEM IN EITHER OF THE CLIPS TO REDUCE THE MEAN BUFFER LEVEL FOR THE SECOND CLIP
174
SECOND CLIP'S MEAN AUDIO BUFFER LEVEL <A ?
175
IF THE ABOVE-DEFINED BEST ALIGNED AAUs DO NOT ACHIEVE A FORWARD SKEW, THEN MODIFY THE BEST ALIGNED AAUs BY APPENDING ONE EXTRA AAU EITHER AFTER THE BEST ALIGNED AAU IN THE FIRST CLIP OR BEFORE THE BEST ALIGNED AAU IN THE SECOND CLIP TO INCREASE THE MEAN BUFFER LEVEL FOR THE SECOND CLIP
176
A

FIG. 24

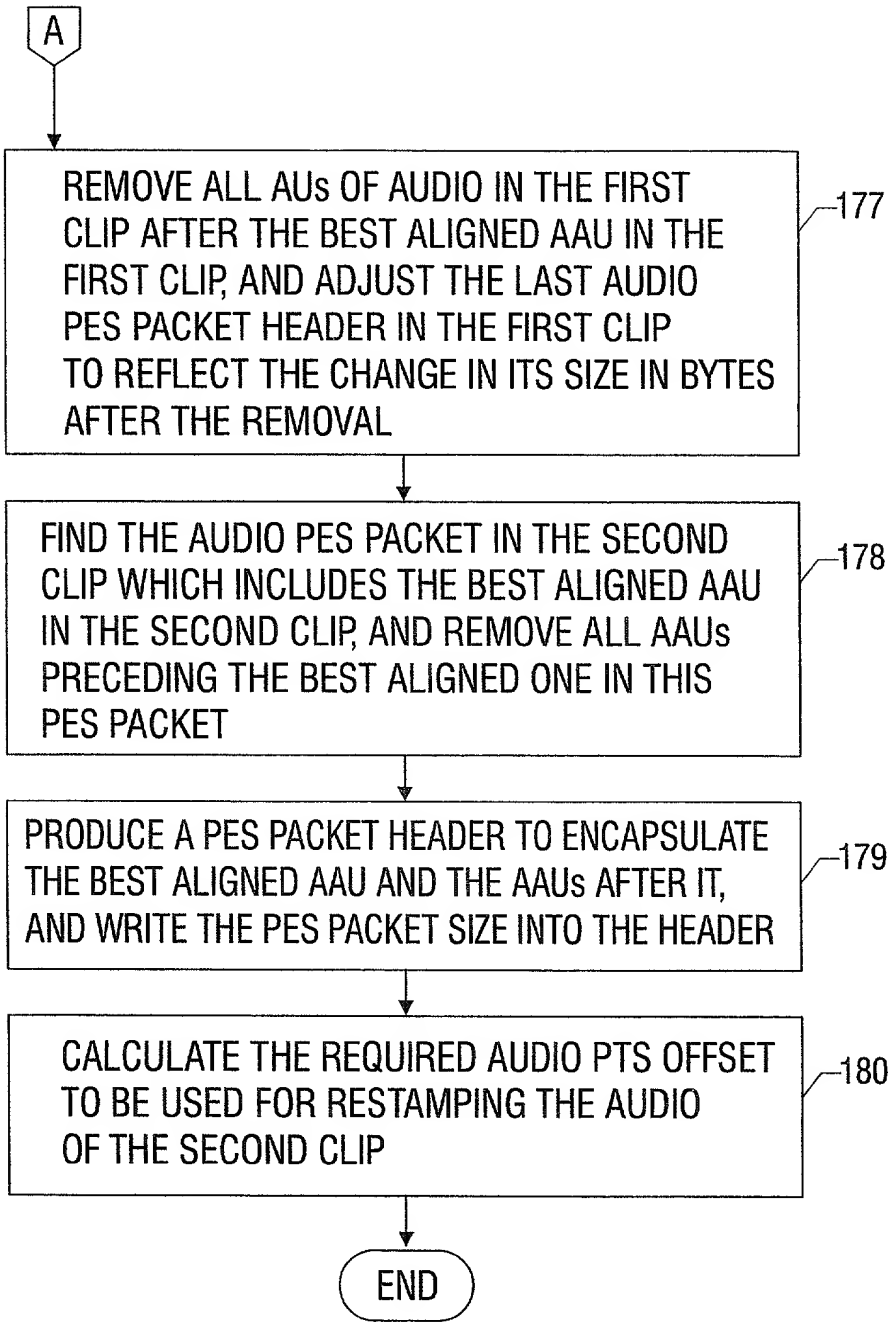

FIG. 25

CASE	SCOND CLIP HAS A HIGH MEAN AUDIO BUFFER LEVEL	SECOND CLIP HAS A LOW MEAN AUDIO BUFFER LEVEL
FIG. 16A	USE FIG. 27	USE FIG16B OR 16C
FIG. 17A	USE FIG. 17B	USE FIG. 28
FIG. 18A	USE FIG. 18B	USE FIG. 29
FIG. 19A	USE FIG. 30	USE FIG. 19B
FIG. 20A	USE FIG. 20B	USE FIG. 31
FIG. 21A	USE FIG. 32	USE FIG. 21B
FIG. 22A	USE FIG. 22B OR 22C	USE FIG. 33
FIG. 23A	USE FIG. 34	USE FIG. 23B

FIG. 26

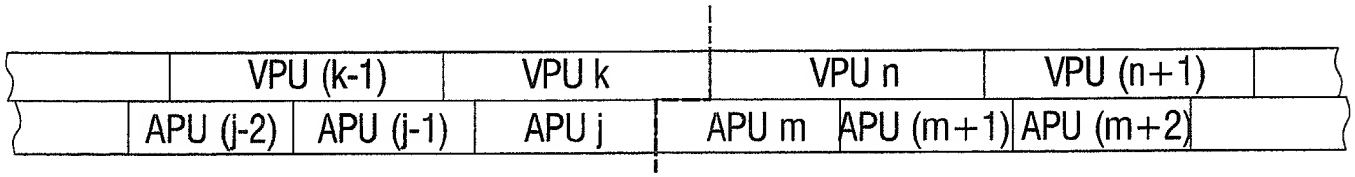

FIG. 27

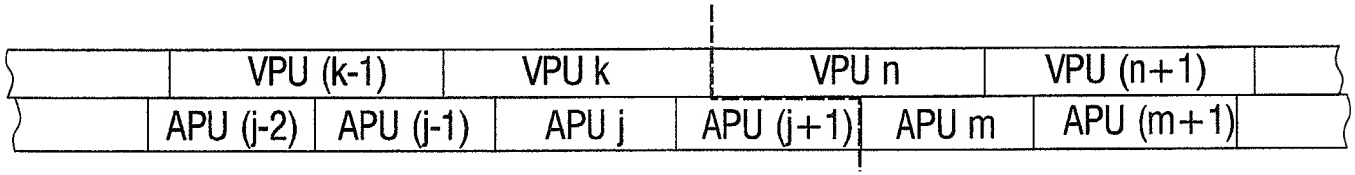

FIG. 28

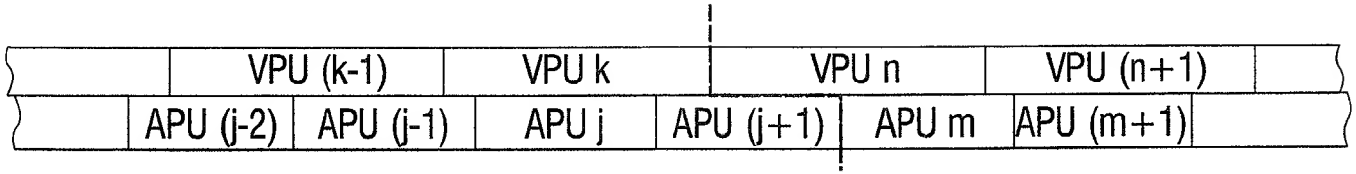

FIG. 29

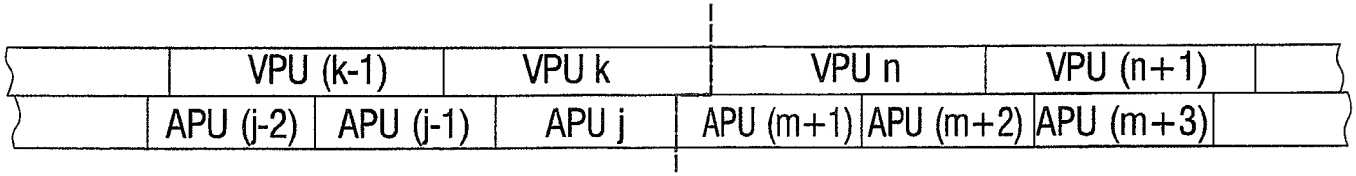

FIG. 30

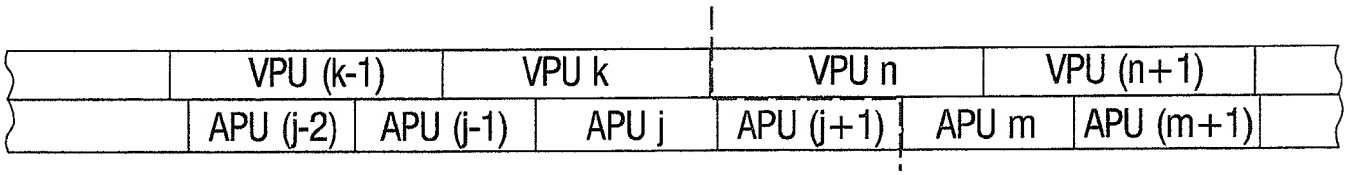

FIG. 31

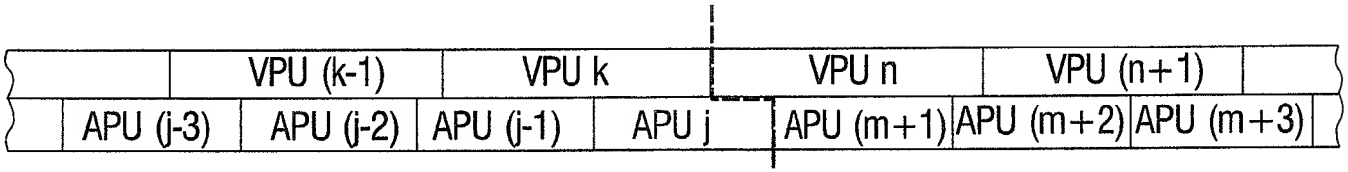

FIG. 32

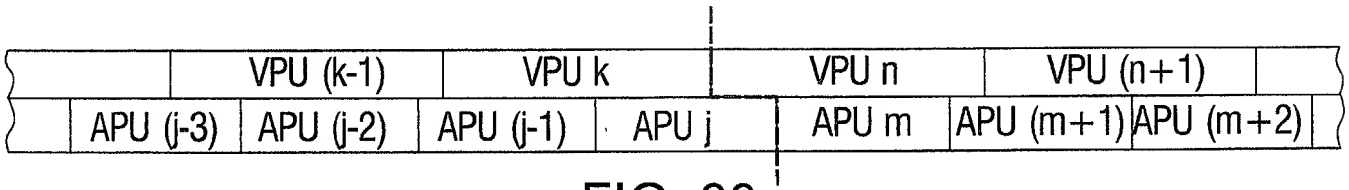

FIG. 33

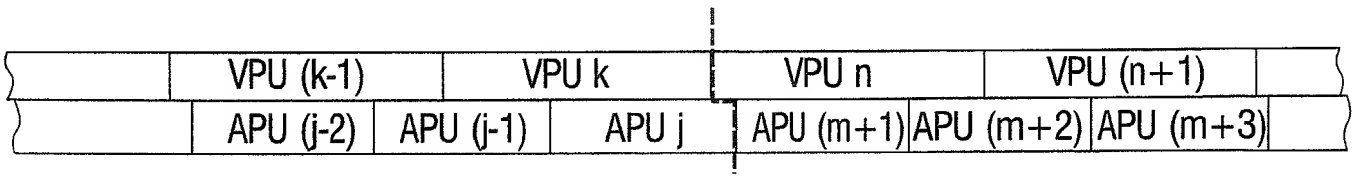

FIG. 34

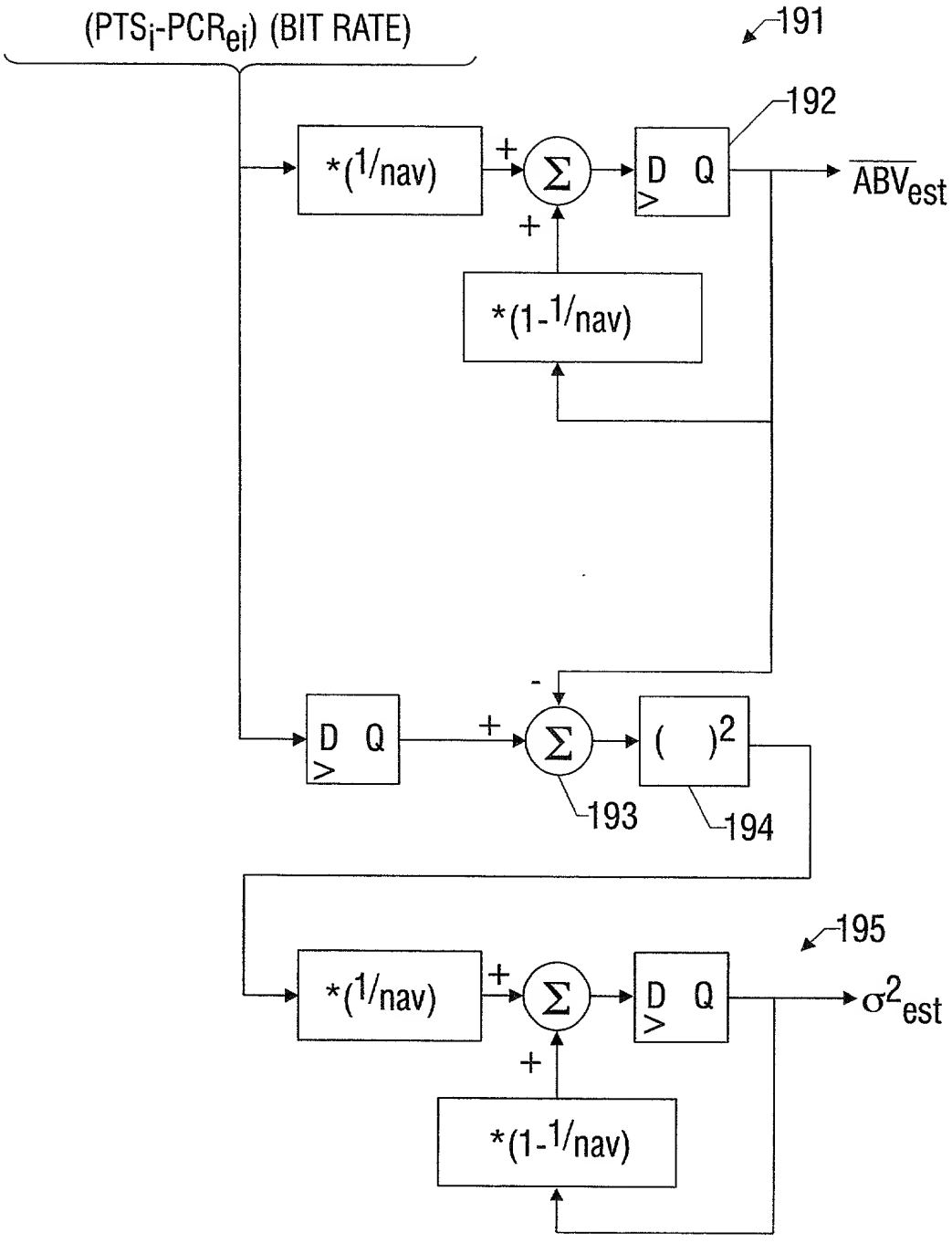
(PTSi-PCRei) (BIT RATE)
191
192
*(1/nav)
+
Σ
D Q
>
ABVest
+
*(1-1/nav)
-
D Q
>
+
Σ
( )2
193
194
195
*(1/nav)
+
Σ
D Q
>
σ2est
+
*(1-1/nav)

FIG. 35

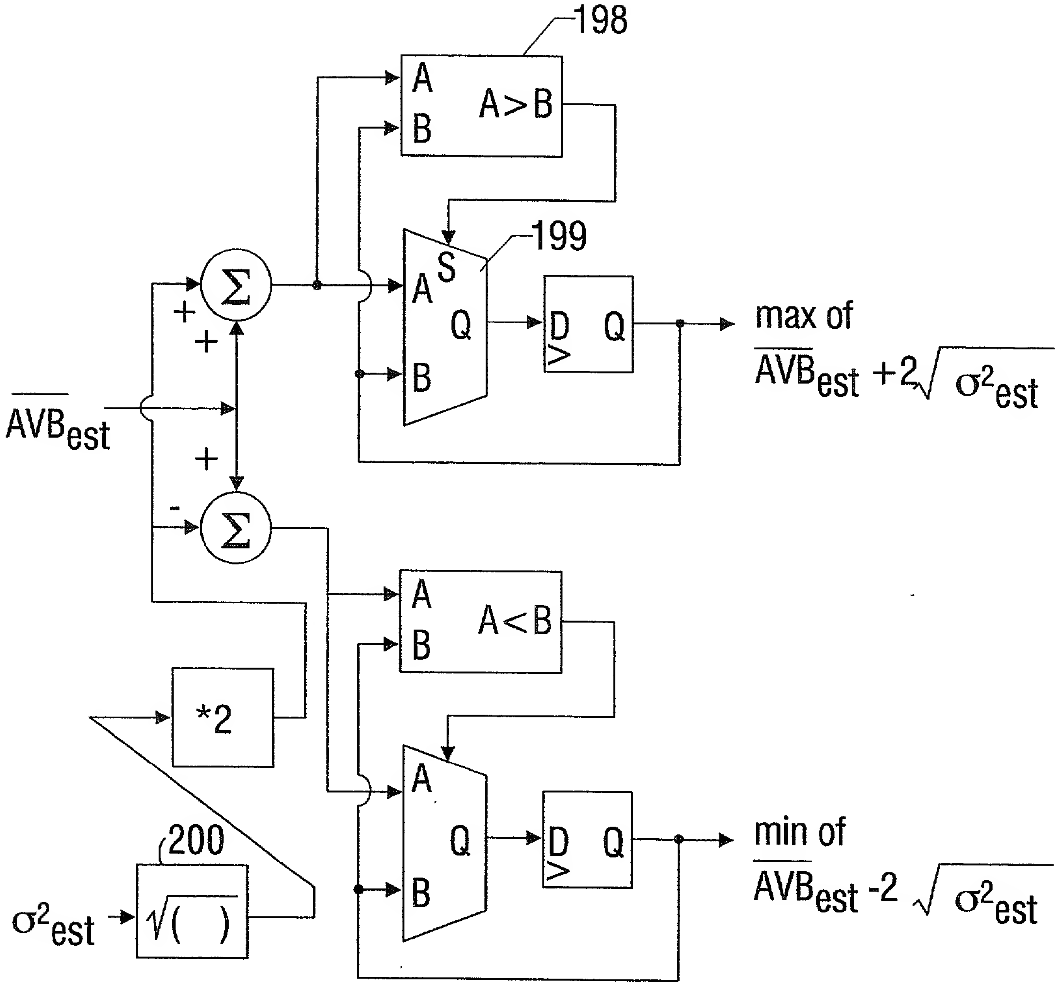
198
A
B
A>B
199
S
A
Q
B
D Q
max of
AVBest +2√ σ2est
AVBest
+
+
+
-
A
B
A<B
*2
A
Q
B
D Q
min of
AVBest -2 √ σ2est
200
σ2est
√( )

FIG. 36